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ABSTRACT

The study attempted to assess student learning and retention in physics following various types of help sessions based on objective-referenced diagnostic tests. Students from an undergraduate physical science course were assigned to one of four treatment groups or a control group. The four treatments consisted of help sessions, each with a different degree of instruction using a list of objectives for each exercise studied in the laboratory and a diagnostic test based on the objectives. At the conclusion of the three-week study a criterion test of physical science laboratory achievement was administered to all students and a similar test of a comprehensive nature was administered six weeks later as a retention test. Results from this study confirm the value of diagnostic tests. All students taking diagnostic tests performed better than the control group students on both criterion tests. (Author/MH)

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THE EFFECTS OF DIAGNOSTIC TESTS AND HELP SESSIONS ON SCIENCE ACHIEVEMENT

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For many years teachers and educational researchers have devoted considerable energy developing techniques and materials that are potentially useful in aiding students to learn. Although many different aspects of teaching and learning have been studied, the basic concern has always been toward improving the process by which students can learn in the most effective manner.

Frieder (1970), Keller (1968), Hickey and Hoffman (1973), and Bloom (1970) have each placed special emphasis on the role of diagnosis and prescription in the development and operation of an effective instructional program. Regardless of the instructional mode used (e.g., pencil-paper, audio-visual, proctor-assisted) when presenting diagnostic-prescriptive instruction, three basic components are usually present: (1) performance objectives to describe pupil learning outcomes, (2) diagnostic tests referenced to the objectives, and (3) remedial instruction based on results of the diagnostic tests. Certain educational research has indicated that it is the manipulation of these components in various learning situations that often produces variation in student achievement.

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When collectively considering performance objectives, diagnostic testing, and remediation, the component which is most difficult to prescribe adequately for learners is remediation. In recent years, this component has received increasing attention especially by colleges and universities which have had to provide remediation for students due to an "open admission policy". Since this policy allows for greater diversity among the abilities of students attending these institutions, remediation has been found to be a necessary factor in meeting the educational needs of certain students.

One of the oldest approaches to remediation is the help session. Help sessions are usually structured according to what a particular teacher feels his or her students need in learning. Quite often, the teacher will schedule a help session at the end of a particular unit of material. This is done when it is felt that the mastery of a new unit of material will depend heavily on the mastery of the proceeding one. In other instances, teachers may also choose to establish periodic help sessions within a course based on prior knowledge of difficulties that students usually encounter. Teachers may also schedule help sessions at the request of students at which time the teacher will not attempt to provide students with information, but instead, serve as a resource person by answering questions that student pose.

The different approaches to conducting help sessions would seem to imply that they may be as different as the teachers in charge. Despite the individual differences among teachers, help sessions traditionally have placed emphasis on reteaching information that the teacher feels is potentially more difficult for students to learn and also allowing students to ask questions. Within this traditional approach lies two basic learning techniques: (1) reteaching of non-mastered material, and (2) allowing student questions about non-mastered material. When observing these two learning techniques as they

are usually provided, it becomes apparent that if diagnostic and prescriptive procedures were employed, student achievement would have a good chance to be improved. Considering this possibility, it was the purpose of this research to study ways of effectively incorporating diagnostic and prescriptive procedures into help sessions.

MEHTODOLOGY

The subjects for the investigation consisted of 97 undergraduate physical science students with no college-level physical science background. They represented five of the 25 laboratory classes associated with a physical science course with 16 to 24 subjects in each. Because students were assigned at random to these laboratory classes at the time of course registration, they were treated as though they were assigned randomly at the time of the investigation. In addition, treatments were assigned to all subjects in a designated laboratory class rather than different treatments within a class.

For this investigation, three of a possible ten laboratory exercises associated with the physical science course were used. Each laboratory exercise was scheduled for two hours per week with all laboratory classes in the study being conducted by the investigator with the aid of five teaching assistants.

The materials used in the study consisted of performance objectives for each of the three laboratory exercises, diagnostic test items for each performance objective, and a posttest for the laboratory exercises that was based on the objectives. The final laboratory examination given to all students in the course six weeks later was used to measure retention and was developed by teachers and laboratory assistants responsible for the entire course.

Help sessions of 3 different types with varying amounts and kinds of

assistance to students were planned. These included:

a. Reteaching incorrect student responses (teacher identifies individual student needs from diagnostic test results and reteaches accordingly.)

b. Encouraging questions from students (students identify their own needs from diagnostic test results and are encouraged by the teacher to ask questions.)

c. Providing knowledge of results on diagnostic tests but no additional assistance (students identified their own needs from diagnostic test results, but lack of teacher comment on the test results and little opportunity for teacher assistance discouraged student questions.)

To facilitate the investigation of these three types of help sessions, treatments were assigned to subjects in each of the five laboratory classes as follows:

1. Group I received the list of objectives for each exercise studied, a diagnostic test based on these objectives, and a help session designed for reteaching incorrect responses on the diagnostic test.

2. Group II received the list of objectives for each exercise studied, a diagnostic test based on these objectives, and a help session designed to encourage students to ask questions concerning items missed on the diagnostic test.

3. Group III also received the list of objectives for each exercise studied, a diagnostic test based on these objectives, and was then instructed to find, on their own, answers to incorrect responses on the diagnostic test.

4. Group IV was treated the same as Group III except that Group IV did not receive the list of objectives.

5. Group V was the control group and therefore did not receive any of the treatments described above.

Figure 1 gives a diagrammatic explanation of assigned treatments according to groups.

Treatments	Groups				
	I	II	III	IV	V
A. Objectives	X	X	X		
B. Diagnostic Tests	X	X	X	X	
C. Help Sessions					
1. Reteach incorrect responses	X				
2. Students encouraged to ask questions		X			
3. Students not encouraged to ask questions			X	X	
D. Posttest	X	X	X	X	X

Figure 1. Treatments received by the five groups of students

At the end of the three-week investigation a posttest was administered to determine the achievement level of each group. Six weeks thereafter, student retention was measured.

RESULTS

Mean scores and standard deviations for the achievement and retention tests are given in Table I. Analysis of these data revealed a highly significant treatment effect. Further analysis using the Newman-Keuls procedure (Kirk, 1968) indicated that Groups I, II, and III scored significantly higher than groups IV and V on the achievement test. Among the three high groups, no significant difference was found between Group I and Group II scores although both were significantly higher than Group III.

TABLE I

Scores For Students On Achievement And Retention Tests

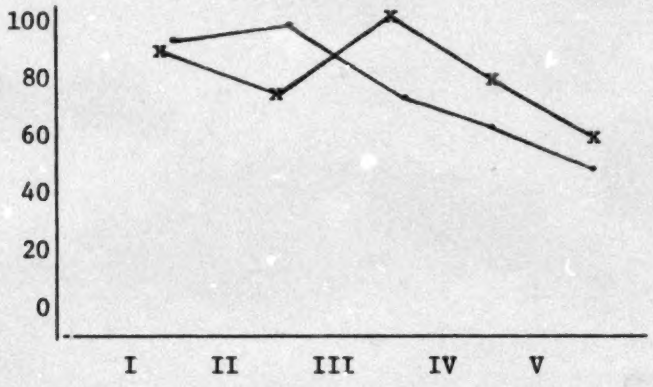
Achievement		Groups				
		I	II	III	IV	V
Test[1]	n	19	16	24	17	21
	$\bar{X}$	82.10	85.75	64.41	56.17	50.71
	SD	8.5	10.1	15.9	13.3	18.2
Retention						
Test[2]	n	13	16	15	11	17
	$\bar{X}$	37.58	35.27	42.33	38.80	28.23
	SD	10.6	12.5	9.5	17.8	16.8

[1] 20-item test, maximum score of 100, Spearman-Brown realiability of .88.

[2] 5-problem test, maximum score of 50, reliability of .69 using Rulon's Method.

Analysis of the retention test scores revealed a non-significant F-ratio although a subsequent Newman-Keul analysis showed the mean scores for Groups III and V to be significantly different.

The mean scores from the two tests are graped in Figure 2.



A summary of the basic conclusions from this study is as follows:

a. Student achievement is greater when objective-based diagnostic tests are used to guide help sessions in which students are encouraged to ask questions.

b. Objective-based diagnostic testing with remediation provides greater student achievement than the lack of remediation.

c. Retention is somewhat greater when students are advised to discover, on their own, correct responses to objective-based diagnostic tests.

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